Original Article

Immunohistochemistry in Cancer Diagnostics in West Africa: Current Applications, Challenges, and Future Prospects

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Article History

Submitted: 15/07/2025; Accepted: 19/08/2025: Published: 31/08/2025

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ABSTRACT

Immunohistochemistry (IHC) is a vital diagnostic tool in cancer pathology, enabling precise tumour classification, prognostication, and treatment stratification. However, its implementation in West Africa is still evolving, constrained by infrastructural, technical, and financial barriers. This study was set out to evaluate the current state of IHC use in cancer diagnostics in West Africa, outline key challenges, highlight regional and global practices, and explore prospects and policy recommendations. This review synthesises data from peer-reviewed publications, regional cancer registries, and institutional reports from 2018 to 2024. It includes global benchmarks, Sub-Saharan African, West African, and Nigerian data sources. IHC is available in major tertiary hospitals across Nigeria, Ghana, and Senegal, but remains limited in rural and secondary facilities. While its use in breast, prostate, and lymphoid malignancies has improved, key gaps include a lack of trained personnel, reagent stock-outs, and the absence of automated platforms. Regional disparities persist, with coverage favouring urban academic centres. Scaling up IHC in West Africa requires investment in infrastructure, training, public-private partnerships, and integration into national cancer control strategies. The need for standardised protocols and digital pathology is also urgent to enhance diagnostic precision.

Keywords: Automated Platforms, Cancer Diagnostics, Immunohistochemistry, Manual Platforms, Pathology Infrastructure, West Africa

INTRODUCTION

Immunohistochemistry (IHC) is a laboratory method that employs antibodies to identify specific antigens (markers) within cells and tissues. The fundamental principle is based on the precise binding of an antibody to its specific antigen, analogous to a lock and key mechanism. These antibodies are typically associated with a detectable marker, including an enzyme or a fluorescent dye. Upon binding of the antibody to the antigen in the tissue sample, the marker is activated, rendering the antigen observable under a microscope[1,2].

IHC is a crucial instrument in clinical diagnostics, especially within anatomic pathology. This method offers essential information that is not always accessible via standard staining techniques[1].

These are common uses in clinical practice. In the diagnosis and Classification of Cancers, Immunohistochemistry (IHC) is utilised to distinguish between different cancer types, such as carcinoma, lymphoma, melanoma, and sarcoma, by identifying specific proteins expressed by the respective cancer cells. Cytokeratins serve as markers for identifying carcinomas [1,3]. In cases of

Article Access

Website: www.wjmbs.org

doi: 10.5281/zenodo.17150798

How to cite this article

Gbaa ZL, Ojo BA, Uko AF, Amina AJ, Inienger DR, Unande HM, Kawen PT, Gbaa FA. Immunohistochemistry in Cancer Diagnostics in West Africa: Current Applications, Challenges, and Future Prospects. West J Med & Biomed Sci. 2025;6(3):211-219. DOI:10.5281/zenodo.17150798.

metastatic cancer with an unknown primary site, immunohistochemistry (IHC) can assist in determining the origin by identifying specific markers linked to various organ tissues [1,4]. Additionally, IHC can aid in differentiating between benign (non-cancerous) and malignant (cancerous) lesions [1]. Numerous cancers exhibit multiple subtypes, and immunohistochemistry (IHC) can assist in their identification. In breast cancer, immunohistochemistry (IHC) is routinely employed to assess the presence of HER2, oestrogen receptors (ER), and progesterone receptors (PR), which are essential for treatment planning [1,5]. IHC can also identify small clusters of tumour cells that may not be visible with standard staining techniques [1]. Furthermore, IHC aids in evaluating cancer aggressiveness, contributing to prognosis and treatment prediction. Markers such as Ki-67 serve as indicators of the proliferation rate of tumour cells [1,6]. Additionally, immunohistochemistry (IHC) identifies characteristics of tumour tissue that can forecast the response of cancer to specific treatments1. HER2 testing in breast cancer is instrumental in assessing the potential efficacy of HER2-targeted therapies, such as trastuzumab, for the patient. Hormone receptor status in breast and prostate guides hormonal therapy [1,5,7]. IHC is a laboratory method that employs antibodies to identify specific antigens (markers) within cells and tissues.

Effectiveness of therapy monitoring: IHC can be used to track how well treatments are preventing or curing illness[1]. Diagnosing Non-Cancerous Conditions -although IHC is most frequently used to identify cancer, it can also be used to diagnose neurodegenerative illnesses such as Parkinson's and Alzheimer's[2]. Dystrophy of the muscles[2]. Infectious disorders by detecting certain pathogens (e.g., viral infections such as adenovirus, EBV, and HSV, or Helicobacter pylori in stomach malignancies)[2,8]. Lynch syndrome is one genetic disorder that raises the risk for some malignancies[2]. IHC can be used to identify particular cells or tissues in trace evidence during forensic investigations[9].

Cancer remains a growing public health concern in Sub-Saharan Africa, with mortality rates alarmingly on the rise, primarily due to pervasive delayed diagnosis and severely inadequate diagnostic infrastructure [10-12]. Patients frequently present at advanced stages, limiting treatment options and worsening prognoses, a direct consequence of insufficient early detection and accessible diagnostic facilities. This dire situation underscores the urgent need for robust diagnostic capabilities to combat the escalating cancer burden across the region.

In contemporary oncology, Immunohistochemistry (IHC) plays a central and indispensable role in patient management. This powerful technique enables highly accurate tumour subtyping, crucial for distinguishing cancer types and guiding prognosis. Furthermore, IHC provides essential therapeutic guidance by identifying specific molecular targets for personalised medicine and is vital for comprehensive biomarker assessment, offering critical insights into disease progression and treatment response[13-15]. These applications are fundamental to optimising treatment strategies and significantly improving patient outcomes globally.

Despite profound global advancements in IHC technology and its widespread integration, many West African countries face persistent systemic challenges impeding the routine adoption. These obstacles are multifaceted, encompassing severe shortages of trained pathologists and histotechnologists, high equipment and reagent costs, and inadequate laboratory infrastructure (e.g., power, cold chain). Fragmented supply chains and limited advanced training exacerbate the establishment of high-quality IHC, creating a significant disparity in cancer care.

Consequently, this review presents an in-depth analysis of the current state of IHC application in West African cancer diagnostics. It will meticulously explore these challenges, identify promising prospects for overcoming them (e.g., telepathology, international collaborations, capacity-building), and provide comprehensive comparisons with global and regional standards. This examination is vital for informing strategic interventions and fostering sustainable improvements in cancer diagnostics, ultimately contributing to reduced mortality and enhanced patient care across West Africa.IHC enhances histopathological interpretation, especially in diagnostically challenging neoplasms[16]. In low-resource settings, it bridges the gap where molecular diagnostics are unavailable[17].

MATERIALS AND METHODS

This descriptive, cross-sectional narrative review synthesised quantitative and qualitative evidence on the availability and distribution of manual versus automated immunohistochemistry (IHC) platforms in selected West African countries.

A structured Microsoft Excel data extraction matrix was designed to ensure uniformity, capturing: country, IHC platform type (manual/automated), availability (percentage/proportion), year of report, source type (peer-reviewed, technical report, grey literature, expert correspondence), and contextual notes (e.g., laboratory capacity, supply chain status, staffing, and training). Data were collated from multiple sources between January and June 2025, including:

- Peer-reviewed articles (2010–2025) from PubMed, Scopus, Web of Science, and AJOL.
- Grey literature from WHO, IARC, and African Pathology Association reports.
- Government laboratory audit reports from the Ministries of Health of Nigeria, Ghana, Senegal, Liberia, and Sierra Leone.
- Expert correspondence with senior histopathologists and biomedical scientists for recent or unpublished updates.

The literature search used Boolean combinations: (“immunohistochemistry” OR “IHC”) AND (“West Africa” OR “Nigeria” OR “Ghana” OR “Senegal” OR “Liberia” OR “Sierra Leone”) AND (“manual IHC” OR “automated IHC”) AND (“availability” OR “distribution”) AND (“cancer diagnostics” AND “pathology” AND “Sub-Saharan Africa”). Searches were limited to English-language publications from January 2010 to June 2025, with additional sources identified from reference lists.

Conflicting data were reconciled through expert validation, Prioritising the most recent and reliable sources. Quantitative data were analysed using descriptive statistics in IBM SPSS v27, with results presented as proportions and percentages. Visualisations (stacked and horizontal bar charts) were generated in Python's Matplotlib and refined in Excel 365. Qualitative findings, including infrastructure and system-level barriers, were narratively synthesised.

Current Utilisation of IHC in West Africa

In Nigeria, studies indicate that Immunohistochemistry (IHC) services are available in about 30–50% of tertiary centers[18-21]. This availability is largely confined to urban institutions, creating significant disparities in access for rural populations. Commonly used IHC panels include essential markers for breast cancer (ER, PR, HER2), Prostate-Specific Antigen (PSA) for prostate cancer, and CD3/CD20/LCA for lymphomas. This limited and urban-centric access often results in delayed or imprecise diagnoses for a large segment of the Nigerian populace, hindering optimal treatment planning.

In Ghana, Senegal, and Côte d'Ivoire, specific institutions lead regional IHC services. Ghana's Korle-Bu Teaching Hospital and Senegal's Institut Joliot-Curie are prominent examples, demonstrating advanced capabilities. However, even these leading centres face similar, persistent limitations [22-24]. Chronic reagent shortages frequently disrupt service delivery, and a heavy reliance on often unreliable infrastructure, such as consistent power supply and equipment maintenance, remains a significant hurdle. These systemic issues highlight a pervasive regional vulnerability, impacting the consistent provision of high-quality cancer diagnostics across West Africa.

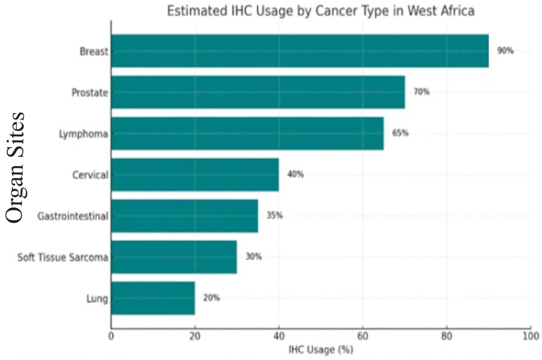

Figure 1: Estimated IHC usage by cancer types in West Africa

A horizontal bar chart illustrating estimated IHC usage by cancer type in West Africa: Breast cancer shows the highest IHC usage (~90%), driven by hormone receptor and HER2 testing. Prostate and lymphomas follow, with moderate adoption of PSA and CD markers. Cervical and gastrointestinal cancers have limited usage, often due to a lack of biomarker integration in routine care. Lung and soft tissue sarcomas are the least supported by IHC, reflecting diagnostic gaps.

Table 1: Availability of IHC in West African Countries

Country	IHC Availability (Tertiary Centres)	Routine Use in Breast Cancer?	Challenges Noted
Nigeria	45–50%	Yes (in major centres)	Cost, reagent stock-outs
Ghana	~60%	Yes	Power outages, training
Senegal	~70% (urban only)	Yes	Maintenance of equipment
Liberia, Sierra Leone	<20%	Rare	No access to IHC labs

Challenges in IHC Implementation in West Africa

Infrastructural limitations severely impede the widespread adoption of Immunohistochemistry (IHC) in West Africa. Many facilities lack access to automated IHC staining platforms, relying instead on manual, labour-intensive processes that are prone to variability and reduce throughout. Furthermore, erratic power supply is a critical issue, disrupting the precise temperature control required for sensitive reagent storage and compromising the integrity of processed slides, directly impacting diagnostic reliability (Figure 1).

Immunohistochemistry (IHC) platform availability in West Africa remains heavily skewed towards manual systems, highlighting critical infrastructural gaps in cancer diagnostics across the region. Nigeria, the most populous country in the region, has approximately 80% manual and 20% automated IHC platform availability. While several tertiary hospitals have invested in automation, most secondary and private laboratories still rely on manual staining methods due to the high costs and technical demands of automated systems[25].

Ghana shows a similar profile with 70% manual and 30% automated platforms. Facilities such as the Korle-Bu Teaching Hospital have contributed to moderate automation, yet peripheral centres remain dependent on manual systems[26].

In Senegal, there is a somewhat more balanced distribution with 60% manual and 40% automated availability. This reflects investments in centralised pathology infrastructure, especially within Dakar and academic institutions[27].

Conversely, Liberia and Sierra Leone have overwhelmingly manual IHC systems, at 95% and 100% respectively, with automated systems either extremely limited or completely absent. These countries still face major post-conflict health system recovery challenges, with limited investment in advanced pathology tools.

This disparity illustrates both inter-country and intra-country inequities in IHC access, where urban academic hospitals may benefit from automation while rural and district hospitals rely on outdated or labour-intensive methods. The predominance of manual platforms increases turnaround time, reduces reproducibility, and limits the ability to scale high-volume diagnostics.

Implications are that Manual IHC methods, although cost-effective, are prone to variability and operator error, affecting diagnostic accuracy and consistency, while Automated platforms are essential for improving quality assurance, standardisation, and integration with digital pathology. This distribution pattern underscores the urgent need for capacity strengthening and equitable investment in diagnostic pathology across the region. (Figure 2 And Table 1)

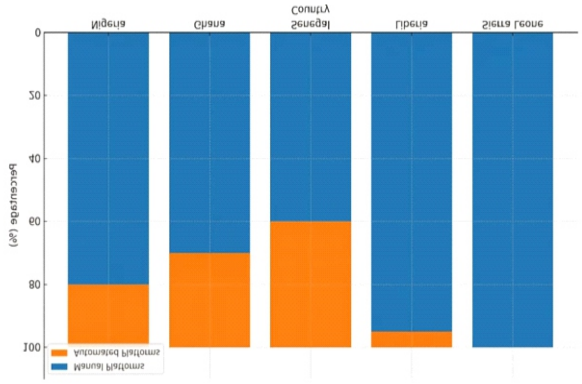

Figure 2: **Manual vs Automated IHC Platform Availability in West Africa**

*A stacked bar chart showing **Manual vs Automated IHC Platform Availability in West Africa**. It visually compares the estimated percentage of manual and automated platforms in five countries, highlighting the dominance of manual platforms across the region.*

Human resource gaps are equally pressing, with a significant scarcity of trained Immunopathologists and histotechnologists28. This limited workforce faces immense pressure, leading to extended turnaround times for diagnoses. The pervasive "brain drain" further exacerbates this, as skilled diagnostic professionals seek opportunities abroad, critically depleting the local expertise pool (Figure 3)[29-31].

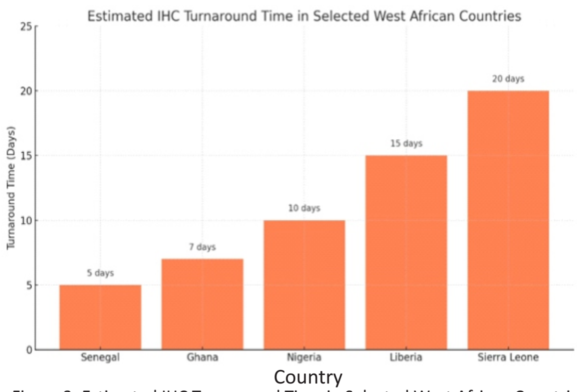

Figure 3: Estimated IHC Turnaround Time in Selected West African Countries

This chart illustrates the estimated turnaround time (TAT) for immunohistochemistry (IHC) results in selected West African countries: Senegal and Ghana have relatively shorter TATs (5–7 days), reflecting better infrastructure and reagent availability. Nigeria averages around 10 days, though times vary widely between centres. Liberia and Sierra Leone experience prolonged delays (15–20 days), often due to external processing, reagent shortages, and limited pathologist access. While global centres benefit from EQA programs and automation, West Africa lags significantly, relying on manual staining and subjective interpretation [29-34]. (Figure 3 and Table 1)

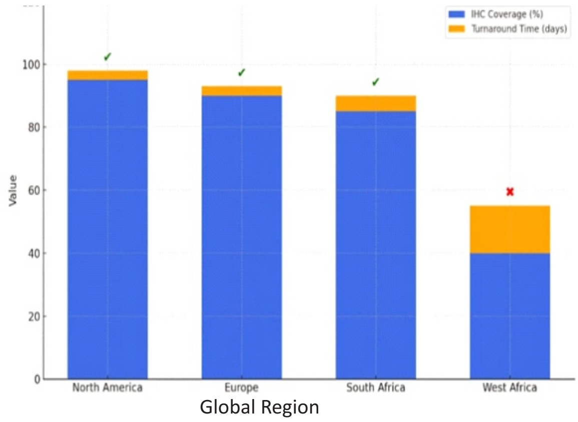

Figure 4: IHC: Global and Regional Comparisons

*This figure highlights the contrast between **global standards** and the **West African context**, especially in terms of **coverage, TAT, and QC absence**.*

Table 2: Global and Regional Comparisons

Region	Average IHC Coverage in Hospitals	Quality Control Programs Present?	Turnaround Time
North America	>95%	Yes (e.g.,CAP, CLIA)	1 – 3 days
Europe	>90%	Yes	1 – 3 days
South Africa	~85%	Yes (SANAS-accredited)	2 – 5 days
West Africa	~40%	No	5 – 15 days or more

CAP – College of American Pathologists: A U.S.-based professional organization that accredits clinical laboratories worldwide to ensure they meet rigorous standards for quality, accuracy, and safety in pathology and laboratory medicine.

CLIA – Clinical Laboratory Improvement Amendments: U.S. federal regulations that set quality standards for all laboratory testing (except research) performed on humans, ensuring accurate, reliable, and timely results.

SANAS – South African National Accreditation System: South Africa's official body for accrediting laboratories, certification bodies, and inspection entities to ensure they meet international standards, often aligned with ISO guidelines.

Financial and logistical barriers present significant hurdles. The high cost of IHC reagents, often inflated by importation duties and taxes, makes the technology prohibitively expensive for many institutions. Compounding this, customs delay frequently leads to antibodies expiring or being damaged during transit, resulting in substantial financial losses and service interruptions.

In summary, significant gaps in quality assurance severely erode confidence in diagnostic outcomes. Without strong external quality assurance (EQA) programs, there is no standardized oversight to ensure the reliability of IHC results. Variability in tissue fixation techniques and inadequate specimen preservation further degrade sample integrity[35], resulting in inconsistent diagnoses and limiting optimal patient care.

Emerging Opportunities for IHC in West Africa

Exciting emerging technologies are poised to revolutionise IHC in West Africa. Digital pathology platforms, such as Path Presenter and whole-slide imaging systems, are under pilot testing in select African centers[36]. These innovations allow for remote access to digitised slides, facilitating expert consultation and overcoming geographical barriers to diagnosis. Furthermore, AI-assisted IHC interpretation is also being explored, promising to enhance accuracy and efficiency in analysis, especially in resource-limited settings.

Significant capacity-building initiatives are actively strengthening the diagnostic landscape. Programs like the WHO Global Initiative for Cancer Registry Development (GICR), Pathologists Overseas, and the African Cancer Registry Network (AFCRN) are providing crucial support for training and infrastructure development. These efforts are vital for addressing the human resource gaps identified previously[37-39].

Crucially, policy and funding opportunities are opening new doors. National Cancer Control Programs (NCCP) in Nigeria, Ghana, and Senegal now explicitly include IHC as an essential component of cancer care, signalling a vital policy shift. Moreover, public-private collaborations, such as Roche's Africa IHC initiative, are injecting much-needed investment and expertise, promising to improve the accessibility and quality of IHC services across the region[39,40].

Limitations

These included variability in data completeness across countries, heterogeneity in reporting formats, exclusion of non-English publications, and the possibility of changes in IHC capacity after data collection. Nevertheless, triangulation from multiple validated sources and expert verification enhanced reliability.

CONCLUSION

Immunohistochemistry is indispensable for accurate cancer diagnosis, especially in breast, prostate, and hematologic malignancies. While West Africa has made notable progress, widespread disparities, infrastructural limitations, and a lack of standardised quality assurance continue to hinder full integration. Strategic investment, training, and collaboration can revolutionise IHC services and contribute to better cancer care outcomes across the region.

Recommendations

To significantly enhance cancer diagnostics in West Africa, a multi-pronged approach focusing on training, infrastructure, standardisation, and funding is essential. We must prioritise comprehensive scale-up training for pathologists and histotechnologists. This can be achieved through dedicated fellowship programs, offering intensive hands-on experience, complemented by flexible online modules to reach a wider audience and ensure continuous professional development.

Simultaneously, establishing regional Immunohistochemistry (IHC) centres of excellence in each West African country is crucial. These centres will serve as hubs for advanced diagnostics, research, and training. To guarantee the reliability of results, we need to create robust regional quality control and standardisation bodies. These bodies will oversee critical aspects like slide preparation, staining protocols, and reporting, ensuring consistent, high-quality diagnoses across the region.

Financial accessibility is also a key barrier. Including IHC in national insurance and cancer programs will significantly offset patient costs, making these vital diagnostic tools available to more individuals. Finally, fostering strong public-private partnerships is vital for stabilising the supply chain of essential reagents and equipment, and for driving digital innovations that can further streamline pathology services and improve patient outcomes.

Acknowledgement

We are thankful to our various management of the university in and the College of Health Sciences institutions for the use of their rich library resources.

Conflicts of interest: none.

Sources of funding: none.

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